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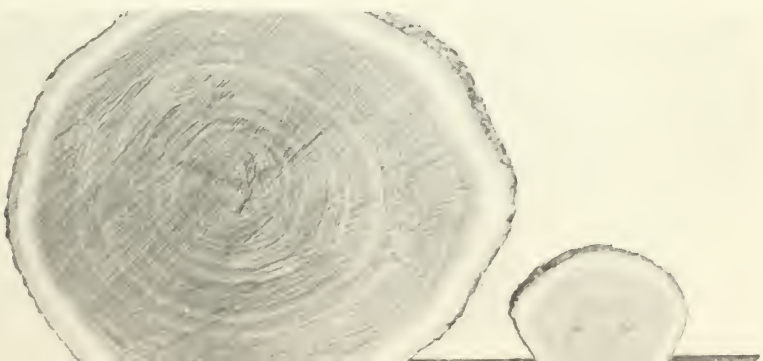
TREE DIAMETER A POOR INDICATOR OF AGE IN WEST VIRGINIA HARDWOODS

Foresters generally recognize that diameter growth, height growth, sprouting vigor, and seed production are partially related to age; so age often has an important bearing upon silvicultural decisions. But unless past stand histories are fully known, the ages of hardwood trees can be determined only by increment borings, which not only require excessive time but also expose the trees to stain and decay. As an alternative, many foresters assume that for silvicultural purposes tree diameter at breast height is accurate enough as a guide to tree age. For managed even-aged stands, this assumption may hold true. But for unmanaged mountain hardwoods, a recent investigation on the Fernow Experimental Forest, Parsons, West Virginia, has revealed extreme variability in the tree age-d.b.h. relationship (fig. 1).

A random sample of 360 trees, restricted to six species, was selected from trees recently harvested from several hardwood stands. Prior to cutting, these stands exhibited a more or less typical uneven-aged diameter distribution. The cutting removed all stems above 4 to 5 inches d.b.h.

Figure 1.—These two cross-sections cut from red oak stumps illustrate the range in tree size for a given age. Both trees were 55 years old. They grew 40 feet apart on a site-index 60 area.



except a few vigorous high-quality seed trees of desirable species. This type of cutting provided an opportunity for a representative sample throughout a wide range of ages and size classes.

For each sample tree, d.b.h. and number of annual rings at stump height (approximately 1 foot) were determined; and the site index class[1] in which the sample occurred was recorded. Red oak (*Quercus rubra* L.), which was well represented on all three site-index classes covered in this

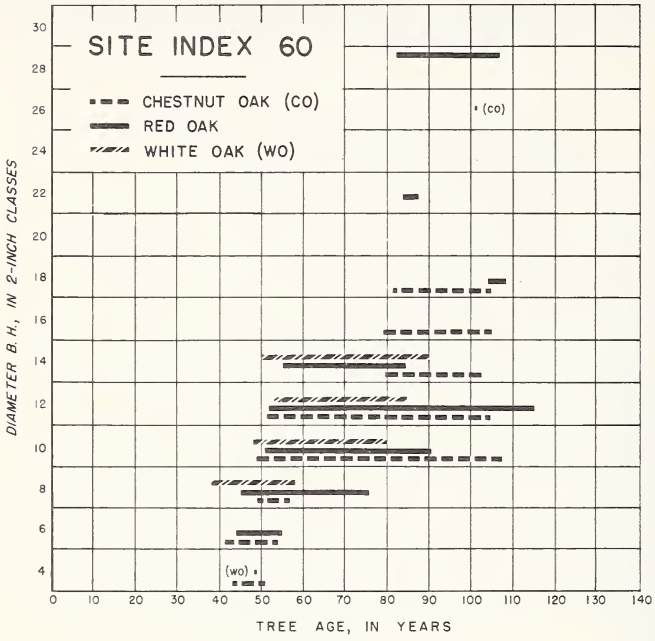


Figure 2.—Range in age by d.b.h. class, site index 60.

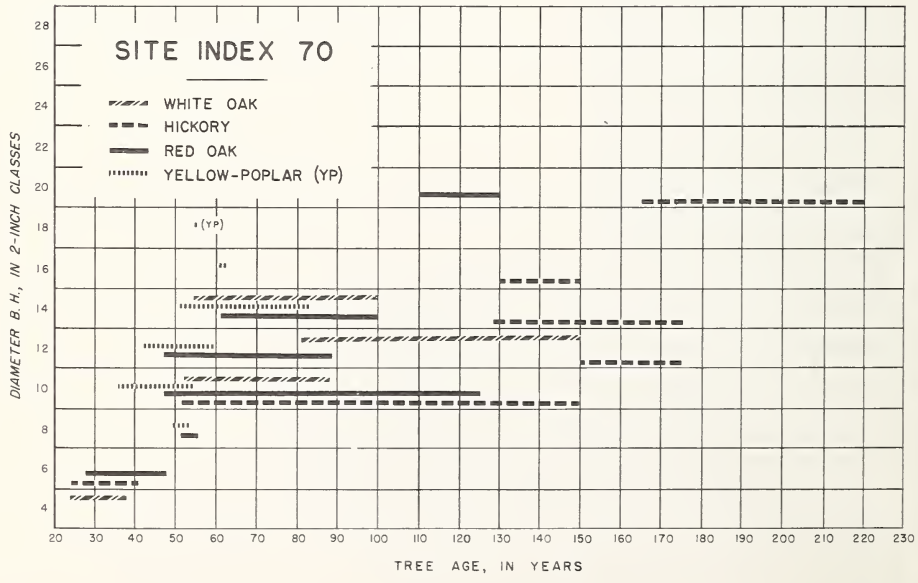


Figure 3.—Range in age by d.b.h. class, site index 70.

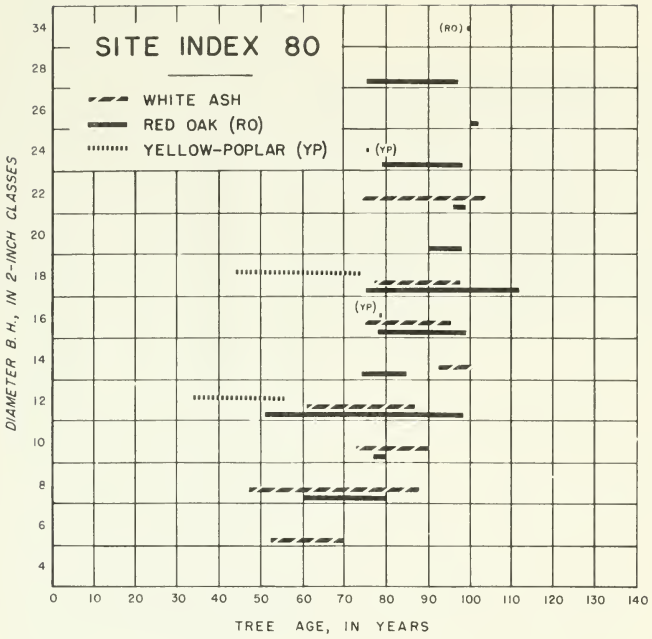


Figure 4.—Range in age by d.b.h. class, site index 80.

study, was the predominant species. The other species were hickory (*Carya* spp.), chestnut oak (*Q. prinus* L.), yellow-poplar (*Liriodendron tulipifera* L.), white oak (*Q. alba* L.), and white ash (*Fraxinus americana* L.).

The results showed that age varies widely within a narrow range of d.b.h. (figs. 2, 3, and 4). For all species and sites, the greatest variability in age generally occurred in the 10-, 12-, and 14-inch d.b.h. classes. The maximum range within any d.b.h. class was 42 to 175 years for 12-inch trees on site index 70. The extreme variability in these middle d.b.h. classes was due to the presence of young thrifty dominants and codominants in mixture with older intermediate and suppressed trees.

Hickory showed the greatest range in age of all species that were studied—no doubt because of its longevity and tolerance. The maximum range for this species in any d.b.h. class was 51 to 150 years for 10-inch trees on site index 70. Red oak, although generally considered to be an intolerant species, was a fairly close second; the maximum spread in age was 47 to 125 years for 10-inch trees on site index 70. Generally speaking, yellow-poplar showed the least range in age within d.b.h. classes of all species. One of the reasons for this may be the relatively narrow total range in age of the yellow-poplar in the study area: nearly all trees of this species came in after heavy cutting of the virgin forests between 50 and

[1] Trimble, G. R., Jr., and Weitzman, Sidney. Site index studies of upland oaks in the northern Appalachians. Forest Sci. 2: 162-173, illus., 1956.

80 years ago. Also, yellow-poplar is very intolerant and usually occurs in even-aged groups.

The relationships between age and d.b.h. were examined from another viewpoint: the maximum range in d.b.h. within any 10-year age class by species and site-index class (figs. 2, 3, and 4). Of all species, red oak exhibited the greatest range in d.b.h. by age class. For the 100-year age class on site index 80, d.b.h. of red oak ranged from 12 to 34 inches. Only a slightly smaller range occurred for red oak in the 80-year age class on site index 60. White oak and hickory showed the least variation of all species in d.b.h. by age class. Apparent differences between species were probably due in part to unequal sample sizes and sampling variation.

Past research in mountain hardwood stands has shown that diameter growth varies by site for trees in the highest two or three vigor classes.[2] But in this study of unmanaged stands, differences in growth rate among sites could not be compared because of the limited amount of data, variable stand histories, and lack of observations on tree vigor. For the same reasons, no comparisons among sites could be made of the variability in the age-d.b.h. relationships.

This study, which is supported by similar findings in northern hardwoods of New Hampshire,[3] clearly indicates that in unmanaged mountain hardwoods, age estimates based solely upon tree d.b.h. must be viewed with caution. The extreme variability of the tree age-size relationship presents for the forest manager questions that bear directly on the successful application of silvicultural practices. For example:

- Will growth responses after silvicultural treatment vary appreciably among trees of the same size but different ages?
- Will the amount and vigor of sprouting be more closely related to tree size or age?

Until research can provide answers to these and similar questions, evaluation of the impact of age and size variability upon silvicultural practices in unmanaged mountain hardwoods must be based to a large extent upon practical experience.

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[2] Trimble, George R., Jr. Relative diameter growth rates of five upland oaks in West Virginia. Jour. Forestry 58: 111-115, illus., 1960.

[3] Blum, Barton M. Age-size relationships in all-aged northern hardwoods. U.S. Forest Serv. Northeast Forest Expt. Sta. Forest Res. Note 125, 3 pp., illus., 1961.